Data Classification and Summarization with IBM Granite

Analisis Tren Pemakaian Obat di RSUD Kota Bandung Tahun 2015-2024 dengan IBM Granite

Oleh :
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Pendahuluan

Latar Belakang, Rumusan Masalah, dan Tujuan

Latar Belakang

- Pemerintah berupaya mengendalikan biaya obat dengan menerbitkan berbagai peraturan terkait yaitu Permenkes No. HK 02.02/Menkes/068/I/2010 pasal 8, tentang kewajiban menggunakan obat generik di fasilitas pelayanan kesehatan milik pemerintah serta program Jaminan Kesehatan Nasional (JKN) pada tahun 2014.
- Analisis trend dari penggunaan obat yang didapatkan dapat memberikan informasi mengenai gambaran, evaluasi dan kegiatan terkait penggunaan obat di RSUD Bandung selama 2015 hingga 2024.
- IBM Granite merupakan model dasar AI yang dikembangkan oleh IBM untuk aplikasi bisnis dengan kemampuan untuk berbagai tugas, termasuk analisis bahasa, kode, dan deret waktu.

Rumusan Masalah

1. Bagaimana tren penggunaan obat generik vs non-generik dari tahun 2015–2024?
2. Bagaimana variasi pemakaian berdasarkan ruangan?
3. Bagaimana IBM Granite dapat membantu memberikan ringkasan dan rekomendasi dari data tersebut?

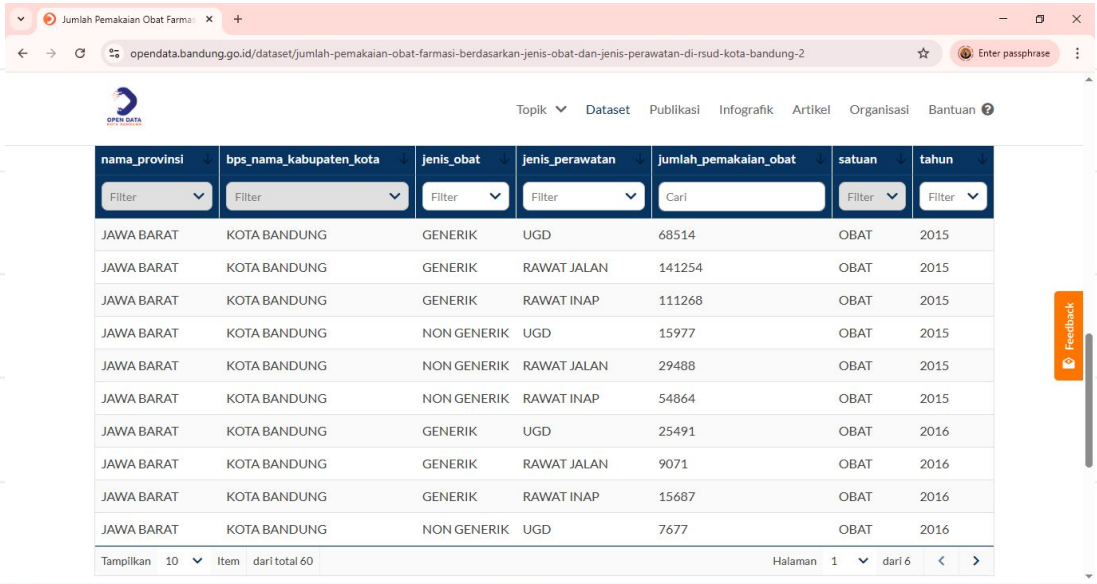
Tujuan

1. Mengklasifikasikan tren data pemakaian obat berdasarkan jenis dan tahun.
2. Menganalisis perbandingan penggunaan obat antar ruangan.
3. Menghasilkan ringkasan tren dan rekomendasi menggunakan IBM Granite.

02
Metodologi

Sumber Data dan Teknik Analisis

Sumber Data



nama_provinsi	bps_nama_kabupaten_kota	jenis_obat	jenis_perawatan	jumlah_pemakaian_obat	satuan	tahun
Filter	Filter	Filter	Filter	Cari	Filter	Filter
JAWA BARAT	KOTA BANDUNG	GENERIK	UGD	68514	OBAT	2015
JAWA BARAT	KOTA BANDUNG	GENERIK	RAWAT JALAN	141254	OBAT	2015
JAWA BARAT	KOTA BANDUNG	GENERIK	RAWAT INAP	111268	OBAT	2015
JAWA BARAT	KOTA BANDUNG	NON GENERIK	UGD	15977	OBAT	2015
JAWA BARAT	KOTA BANDUNG	NON GENERIK	RAWAT JALAN	29488	OBAT	2015
JAWA BARAT	KOTA BANDUNG	NON GENERIK	RAWAT INAP	54864	OBAT	2015
JAWA BARAT	KOTA BANDUNG	GENERIK	UGD	25491	OBAT	2016
JAWA BARAT	KOTA BANDUNG	GENERIK	RAWAT JALAN	9071	OBAT	2016
JAWA BARAT	KOTA BANDUNG	GENERIK	RAWAT INAP	15687	OBAT	2016
JAWA BARAT	KOTA BANDUNG	NON GENERIK	UGD	7677	OBAT	2016

Tampilkan 10 Item dari total 60 Halaman 1 dari 6

https://opendata.bandung.go.id/dataset/jumlah-pemakaian-obat-farmasi-berdasarkan-jenis-obat-dan-jenis-perawatan-di-rsud-kota-bandung-2

Teknik Analisis

- **Dataset** : Pemakaian Obat di RSUD Kota Bandung Tahun 2015-2024 (.xlsx)
- **Analisis** :
  - Pandas (Python) → penggabungan data per tahun & per ruangan
  - IBM Granite → klasifikasi tren (increase, decrease, stable, fluctuation), ringkasan dan rekomendasi.
  - Matplotlib (Python) → Visualisasi line plot dan bar plot
- **Output** : Tabel, line plot dan bar plot, klasifikasi, ringkasan dan rekomendasi.

Analisis Tren

- Pemakaian obat per tahun
- Pemakaian obat per ruang perawatan
- Pemakaian obat gabungan

Tahapan

Tahap 1 : Persiapan Lingkungan dan Instalasi	Instalasi dan import Library
Tahap 2 : Konfigurasi dan Autentikasi API	Ambil Token API dan inisialisasi Model
Tahap 3 : Pemrosesan Data Awal	Load data dan pembersihan data
Tahap 4 : Analisis dan Agregasi Data	Agregasi data dan transformasi data
Tahap 5 : Klasifikasi dengan IBM Granite	Menyiapkan prompt dan mengirim ke Model
Tahap 6 : Visualisasi	Visualisasi data
Tahap 7 : Rekomendasi dengan IBM Granite	Menyiapkan prompt dan mengirim ke Model

03
Hasil dan Analisis

Analisis Tren Pemakaian Obat per Tahun

1. Klasifikasi tren pemakaian obat per tahun

```
# --- Klasifikasi pemakaian obat per tahun ---
# Klasifikasi data jumlah pemakaian obat per tahun dan jenis obat
klasifikasi_tahun = df.groupby(["tahun", "jenis_obat"])["jumlah_pemakaian_obat"].sum().reset_index()
print(klasifikasi_tahun)

# Ubah tabel ke string untuk dimasukkan ke LLM
tahun_str = klasifikasi_tahun.to_string(index=False)

# Prompt untuk Granite
prompt = f"""
"
Classify the trend of drug usage (increasing, decreasing, stable, fluctuating) for each year with format :
year : ...

Data:
{tahun_str}
"""
# Kirim ke Granite
result = ask_granite(prompt)
print(result)
```

Analisis Tren Pemakaian Obat per Tahun

Output :

	tahun	jenis_obat	jumlah_pemakaian_obat
0	2015	GENERIK	321036
1	2015	NON GENERIK	100329
2	2016	GENERIK	50249
3	2016	NON GENERIK	19787
4	2017	GENERIK	85532
5	2017	NON GENERIK	14410
6	2018	GENERIK	68383
7	2018	NON GENERIK	8796
8	2019	GENERIK	72592
9	2019	NON GENERIK	7774
10	2020	GENERIK	37513
11	2020	NON GENERIK	3510
12	2021	GENERIK	345200
13	2021	NON GENERIK	22083
14	2022	GENERIK	472717
15	2022	NON GENERIK	25143
16	2023	GENERIK	557159
17	2023	NON GENERIK	24744
18	2024	GENERIK	662562
19	2024	NON GENERIK	109644

2015: Stable (both GENERIK and NON GENERIK show consistent usage without significant increase or decrease)
2016: Decreasing (both GENERIK and NON GENERIK show a drop in usage from 2015)
2017: Increasing (both GENERIK and NON GENERIK show an increase in usage from 2016)
2018: Decreasing (both GENERIK and NON GENERIK show a drop in usage from 2017)
2019: Increasing (both GENERIK and NON GENERIK show an increase in usage from 2018)
2020: Decreasing (both GENERIK and NON GENERIK show a drop in usage from 2019, likely due to the global pandemic)
2021: Increasing (both GENERIK and NON GENERIK show a significant rise in usage from 2020, possibly due to post-pandemic recovery)
2022: Increasing (both GENERIK and NON GENERIK continue to show growth from 2021)
2023: Increasing (both GENERIK and NON GENERIK show further growth from 2022)
2024: Increasing (both GENERIK and NON GENERIK display substantial growth from 2023, with NON GENERIK experiencing a more pronounced increase).

Analisis Tren Pemakaian Obat per Tahun

2. Ringkasan dan rekomendasi pemakaian obat per tahun

```
# --- Analisis pemakaian obat per tahun ---
# Klasifikasi data jumlah pemakaian obat per tahun dan jenis obat
klasifikasi_tahun = df.groupby(["tahun", "jenis_obat"])["jumlah_pemakaian_obat"].sum().reset_index()

# Ubah tabel ke string untuk dimasukkan ke LLM
tahun_str = klasifikasi_tahun.to_string(index=False)

# Prompt untuk Granite
prompt = f"""
"
Provide a summary, possible general reasons behind the changes, and brief recommendation in 3 sentences with points

Data:
{tahun_str}
"""
# Kirim ke Granite
result = ask_granite(prompt)
print(result)
```

Analisis Tren Pemakaian Obat per Tahun

Output :

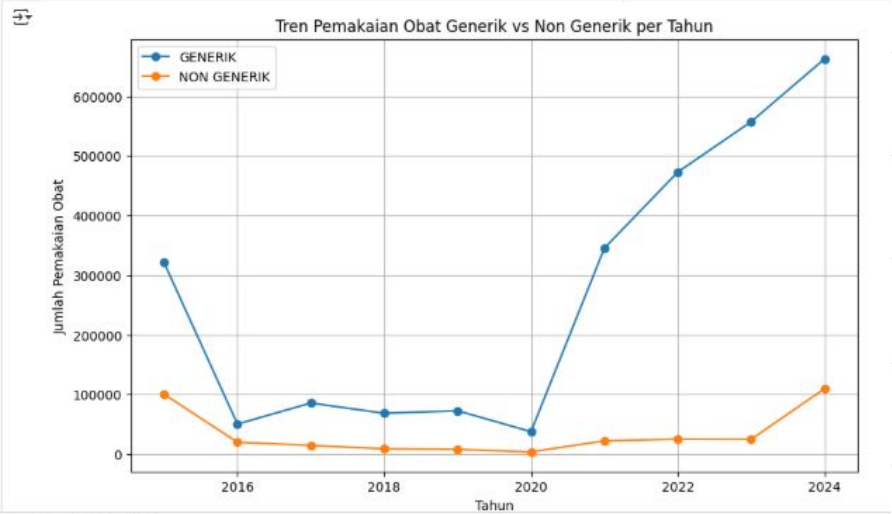
Summary: The data shows a significant increase in the usage of both generic and non-generic medications from 2015 to 2024. However, generic medication usage has seen a more dramatic rise, with a steep surge in 2021 and an exponential growth in 2022, 2023, and 2024. Non-generic medication usage has consistently decreased since 2015, with a sharp drop observed in 2020 and a slight recovery in subsequent years.

```
Summary: The data shows a significant increase in the usage of both generic and non-generic medications from 2015 to 2024. However, generic medication usage has se

Possible general reasons behind the changes:
1. Increased awareness and preference for generic medications due to their cost-effectiveness and perceived safety.
2. Policy changes or regulations promoting the use of generics over branded medications.
3. The impact of the COVID-19 pandemic, which might have affected production, distribution, or consumer behavior differently for generic and non-generic drugs.

Brief recommendation:
1. Encourage continued promotion of generic medications to maintain cost-effectiveness and accessibility in healthcare.
2. Investigate and address any potential supply chain or distribution issues affecting non-generic medications to prevent further decline.
3. Monitor trends and consumer behavior to adapt policies and strategies accordingly, ensuring a balanced market for both generic and non-generic medications.
```

Analisis Tren Pemakaian Obat per Tahun

3. Visualisasi data pemakaian obat per tahun (line plot)

```python
# Tren Line Pemakaian Obat per Tahun
import matplotlib.pyplot as plt

plt.figure(figsize=(10,6))
for jenis in klasifikasi_tahun["jenis_obat"].unique():
    subset = klasifikasi_tahun[klasifikasi_tahun["jenis_obat"] == jenis]
    plt.plot(subset["tahun"], subset["jumlah_pemakaian_obat"], marker="o", label=jenis)

plt.xlabel("Tahun")
plt.ylabel("Jumlah Pemakaian Obat")
plt.title("Tren Pemakaian Obat Generik vs Non Generik per Tahun")
plt.legend()
plt.grid(True)
plt.show()
```



Analisis Tren Pemakaian Obat per Jenis Perawatan

1. Klasifikasi tren pemakaian obat per jenis perawatan

```
# --- Klasifikasi per ruangan ---
# Hitung total pemakaian obat per jenis_perawatan (ruangan) + jenis_obat
klasifikasi_ruangan = df.groupby(["jenis_perawatan", "jenis_obat"])["jumlah_pemakaian_obat"].sum().reset_index()
print(klasifikasi_ruangan)

# Analisis per ruang
ruang_str = klasifikasi_ruangan.to_string(index=False)

# Prompt untuk Granite
prompt = f"""
Here is the drug usage data by hospital room type (inpatient, outpatient, emergency)
and drug type (generic vs non-generic):

{ruang_str}

Please classify the room has the highest and lowest drug usage overall


Data:
{ruang_str}
"""

# Kirim ke Granite
result = ask_granite(prompt)
print(result)
```

Analisis Tren Pemakaian Obat per Jenis Perawatan

Output :

```
  jenis_perawatan   jenis_obat  jumlah_pemakaian_obat
0      RAWAT INAP      GENERIK                1188929
1      RAWAT INAP  NON GENERIK                 156494
2     RAWAT JALAN      GENERIK                 816061
3     RAWAT JALAN  NON GENERIK                 103222
4             UGD      GENERIK                 667953
5             UGD  NON GENERIK                  76504
To determine the room type with the highest and lowest overall drug usage, we need to sum the usage for both generic and non-generic drugs within each room type.

1. **RAWAT INAP (Inpatient):**
   - Generic: 1188929
   - Non-generic: 156494
   - Total: 1188929 + 156494 = 1345423

2. **RAWAT JALAN (Outpatient):**
   - Generic: 816061
   - Non-generic: 103222
   - Total: 816061 + 103222 = 919283

3. **UGD (Emergency):**
   - Generic: 667953
   - Non-generic: 76504
   - Total: 667953 + 76504 = 744457

Comparing the totals:

- Highest overall drug usage: RAWAT INAP with 1345423
- Lowest overall drug usage: UGD with 744457

So, RAWAT INAP has the highest drug usage, and UGD (Emergency) has the lowest drug usage overall.
```

Analisis Tren Pemakaian Obat per Jenis Perawatan

2. Ringkasan dan rekomendasi pemakaian obat per jenis perawatan

```
[ ]  # --- Analisis per ruangan ---
     # Hitung total pemakaian obat per jenis_perawatan (ruangan) + jenis_obat
     klasifikasi_ruangan = df.groupby(["jenis_perawatan", "jenis_obat"])["jumlah_pemakaian_obat"].sum().reset_index()

     # Analisis per ruang
     ruang_str = klasifikasi_ruangan.to_string(index=False)

     # Prompt untuk Granite
     prompt = f"""

     Provide a summary of the comparison across rooms and brief recommendation in 3 sentences with points

     Data:
     {ruang_str}
     """

     # Kirim ke Granite
     result = ask_granite(prompt)
     print(result)
```

Analisis Tren Pemakaian Obat per Jenis Perawatan

Output :

The data shows the usage of generic and non-generic medications across different types of healthcare services:

1. For 'RAWAT INAP' (inpatient care), generic medications are used more frequently (1,188,929 times) compared to non-generic (156,494 times).
2. 'RAWAT JALAN' (outpatient care) also favors generic medications (816,061 times) over non-generic (103,222 times).
3. For 'UGD' (unspecified general diagnosis), generic medications are again preferred (667,953 times), with non-generic usage being less (76,504 times).

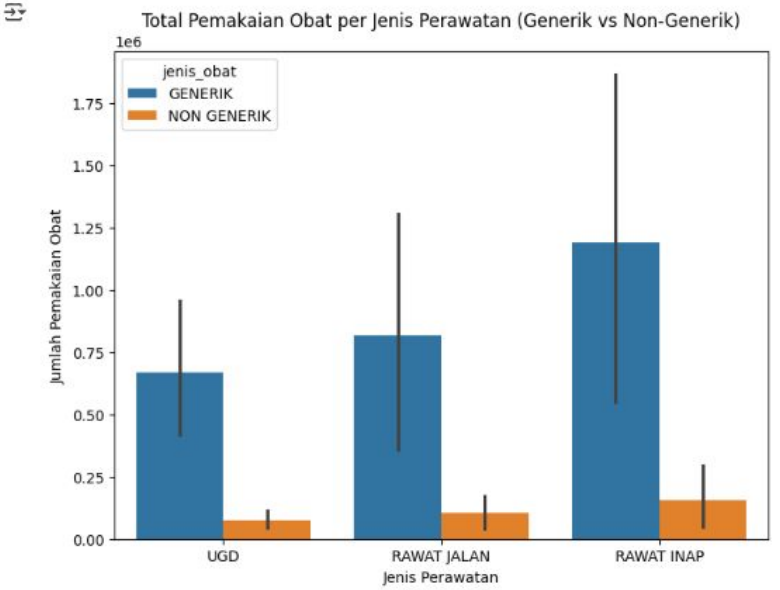
Recommendation:

- Prioritize the procurement and usage of generic medications due to their significantly higher consumption rates across all categories (inpatient, outpatient, and unspecified general diagnosis).
- Review the necessity of non-generic medications, as their usage is considerably lower, to assess if cost-effective generic alternatives could be viable without compromising patient care.
- Implement strategies to increase the adoption of generic medicines, possibly through educational campaigns for both healthcare providers and patients about the efficacy and cost benefits of generics.

Analisis Tren Pemakaian Obat per Jenis Perawatan

3. Visualisasi data pemakaian obat per jenis perawatan (bar plot)

```
[ ]  # Bagan akumulasi pemakaian obat berdasarkan jenis perawatan
     plt.figure(figsize=(8,6))
     sns.barplot(
         data=df,
         x="jenis_perawatan",
         y="jumlah_pemakaian_obat",
         hue="jenis_obat",
         estimator="sum"
     )
     plt.title("Total Pemakaian Obat per Jenis Perawatan (Generik vs Non-Generik)")
     plt.ylabel("Jumlah Pemakaian Obat")
     plt.xlabel("Jenis Perawatan")
     plt.show()
```



Analisis Tren Pemakaian Obat Gabungan

1. Ringkasan dan rekomendasi pemakaian obat

```
[ ]  # --- Analisis gabungan ---
     # Klasifikasi data jumlah pemakaian obat per tahun, jenis perawatan, dan jenis obat
     gabungan = df.groupby(["tahun", "jenis_perawatan", "jenis_obat"])["jumlah_pemakaian_obat"].sum().reset_index()
     print(gabungan.head())

     # Ubah tabel ke string untuk dimasukkan ke LLM
     gabungan_str = gabungan.to_string(index=False)

     # Prompt untuk Granite
     prompt = f"""
     Summarize the usage trends of Generic and Non-Generic drugs across all rooms (inpatient, outpatient, and emergency) and years.
     Highlight major increases or decreases with the corresponding years.

     Data:
     {gabungan_str}
     """
     # Kirim ke Granite
     result = ask_granite(prompt)
     print(result)
```

Analisis Tren Pemakaian Obat Gabungan

Output :

Summary of Generic and Non-Generic Drug Usage Trends

Overall Trends:

- **Generic Drugs:** There has been a consistent increase in the usage of generic drugs across all types of care (inpatient, outpatient, and emergency) from 2015 to 2024. The most significant growth is observed from 2020 to 2024, with a dramatic rise, especially in 2021 and 2022, indicating a strong shift towards generics.

- **Non-Generic Drugs:** Conversely, non-generic drug usage has seen a steady decline across all categories from 2015 to 2024. The decrease is most pronounced from 2020 onwards, aligning with the surge in generic drug usage.

Analisis Tren Pemakaian Obat Gabungan

Output :

Year-by-Year Highlights:

- **2015:** Initial data shows a higher usage of non-generic drugs across all categories, with inpatient care (RAWAT INAP) having the highest numbers for both generic and non-generic drugs.
- **2020:** A notable drop in non-generic drug usage across all categories, coinciding with the beginning of a significant increase in generic drug usage, particularly in outpatient (RAWAT JALAN) and emergency (UGD) services.
- **2021:** A massive increase in generic drug usage, especially in inpatient (RAWAT INAP) and outpatient (RAWAT JALAN) care, reflecting a substantial shift in prescription practices. Non-generic usage continues its downward trend.
- **2022:** Continued growth in generic drug usage, with inpatient and outpatient services showing the highest numbers. Non-generic usage remains low.
- **2023:** Further escalation in generic drug usage, with all categories showing substantial numbers. Non-generic usage remains minimal.
- **2024:** The trend of increasing generic drug usage persists, with the highest numbers recorded for both inpatient (RAWAT INAP) and outpatient (RAWAT JALAN) care, as well as emergency (UGD) services. Non-generic usage is significantly reduced, with only minor figures across all categories.

Analisis Tren Pemakaian Obat Gabungan

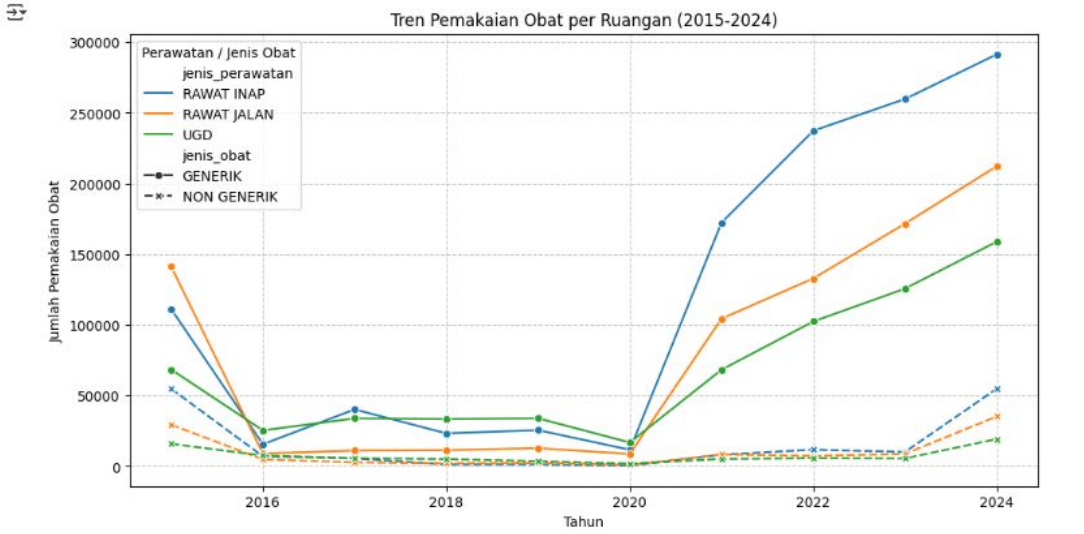
Output :

```
   tahun jenis_perawatan   jenis_obat  jumlah_pemakaian_obat
0   2015      RAWAT INAP      GENERIK                 111268
1   2015      RAWAT INAP  NON GENERIK                  54864
2   2015     RAWAT JALAN      GENERIK                 141254
3   2015     RAWAT JALAN  NON GENERIK                  29488
4   2015             UGD      GENERIK                  68514
### Summary of Generic and Non-Generic Drug Usage Trends

**Overall Trends:**

- **Generic Drugs:** There has been a consistent increase in the usage of generic drugs across all types of care (inpatient, outpatient, and emergency) from 2015 to 2024. The most significant growth is observed from 2020

- **Non-Generic Drugs:** Conversely, non-generic drug usage has seen a steady decline across all categories from 2015 to 2024. The decrease is most pronounced from 2020 onwards, aligning with the surge in generic drug usa

**Year-by-Year Highlights:**

- **2015:** Initial data shows a higher usage of non-generic drugs across all categories, with inpatient care (RAWAT INAP) having the highest numbers for both generic and non-generic drugs.

- **2020:** A notable drop in non-generic drug usage across all categories, coinciding with the beginning of a significant increase in generic drug usage, particularly in outpatient (RAWAT JALAN) and emergency (UGD) servi

- **2021:** A massive increase in generic drug usage, especially in inpatient (RAWAT INAP) and outpatient (RAWAT JALAN) care, reflecting a substantial shift in prescription practices. Non-generic usage continues its downw

- **2022:** Continued growth in generic drug usage, with inpatient and outpatient services showing the highest numbers. Non-generic usage remains low.

- **2023:** Further escalation in generic drug usage, with all categories showing substantial numbers. Non-generic usage remains minimal.

- **2024:** The trend of increasing generic drug usage persists, with the highest numbers recorded for both inpatient (RAWAT INAP) and outpatient (RAWAT JALAN) care, as well as emergency (UGD) services. Non-generic usage
```

Analisis Tren Pemakaian Obat Gabungan

2. Visualisasi data pemakaian obat gabungan (line plot)

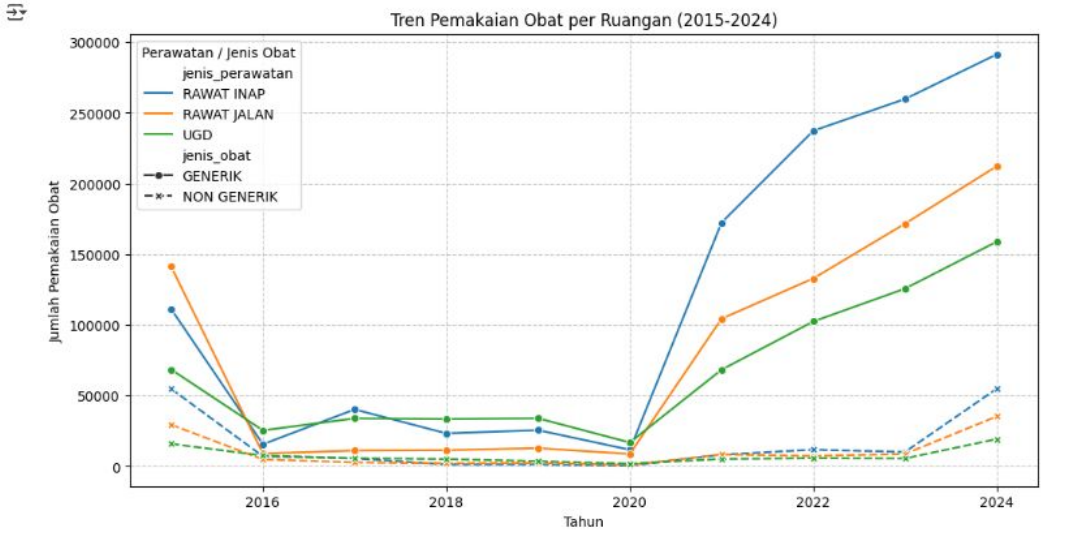
```
# Trend line gabungan pemakaian obat berdasarkan tahun, jenis obat, dan jenis perawatan
# Hitung total pemakaian obat per tahun, jenis obat, dan jenis perawatan
gabungan = df.groupby(["tahun", "jenis_perawatan", "jenis_obat"])["jumlah_pemakaian_obat"].sum().reset_index()

# Grafik gabungan semua ruangan
plt.figure(figsize=(12, 6))
sns.lineplot(data=gabungan, x="tahun", y="jumlah_pemakaian_obat",
             hue="jenis_perawatan", style="jenis_obat", markers=True)
plt.title("Tren Pemakaian Obat per Ruangan (2015-2024)")
plt.xlabel("Tahun")
plt.ylabel("Jumlah Pemakaian Obat")
plt.grid(True, linestyle="--", alpha=0.7)
plt.legend(title="Perawatan / Jenis Obat")
plt.show()
```



Analisis Tren Pemakaian Obat Gabungan

2. Visualisasi data pemakaian obat gabungan (line plot)

```
# Trend line gabungan pemakaian obat berdasarkan tahun, jenis obat, dan jenis perawatan
# Hitung total pemakaian obat per tahun, jenis obat, dan jenis perawatan
gabungan = df.groupby(["tahun", "jenis_perawatan", "jenis_obat"])["jumlah_pemakaian_obat"].sum().reset_index()

# Grafik gabungan semua ruangan
plt.figure(figsize=(12, 6))
sns.lineplot(data=gabungan, x="tahun", y="jumlah_pemakaian_obat",
             hue="jenis_perawatan", style="jenis_obat", markers=True)
plt.title("Tren Pemakaian Obat per Ruangan (2015-2024)")
plt.xlabel("Tahun")
plt.ylabel("Jumlah Pemakaian Obat")
plt.grid(True, linestyle="--", alpha=0.7)
plt.legend(title="Perawatan / Jenis Obat")
plt.show()
```



Analisis Tren Pemakaian Obat Gabungan

2. Rekomendasi data pemakaian obat gabungan

```
# Rekomendasi
# Ubah tabel ke string untuk dimasukkan ke LLM
gabungan_str = gabungan.to_string(index=False)

# Prompt untuk Granite
prompt = f"""
Based on the combined drug usage trends across all rooms and drug types,
provide 3 key recommendations for hospital management to optimize drug usage.
Focus on efficiency, cost-effectiveness, and patient care with 3 sentences.

Data:
{gabungan_str}
"""
# Kirim ke Granite
result = ask_granite(prompt)
print(result)
```

Analisis Tren Pemakaian Obat Gabungan

Output :

1. Prioritize the use of generic drugs to enhance cost-effectiveness, as evidenced by the consistent preference for generics across all categories, significantly reducing expenses without compromising patient care.

2. Implement targeted training programs for medical staff to optimize drug prescription practices, focusing on the appropriate use of non-generic drugs when necessary, ensuring patient care remains uncompromised while minimizing unnecessary costs.

3. Analyze room-specific drug usage trends to identify areas for improvement in resource allocation, such as focusing on reducing non-generic drug use in rooms with high outpatient (RAWAT JALAN) and UGD activity, thereby enhancing overall efficiency and cost-effectiveness.

Analisis Tren Pemakaian Obat Gabungan

Output :

1. Prioritize the use of generic drugs to enhance cost-effectiveness, as evidenced by the consistent preference for generics across all categories, significantly reducing expenses without compromising patient care.
2. Implement targeted training programs for medical staff to optimize drug prescription practices, focusing on the appropriate use of non-generic drugs when necessary, ensuring patient care remains uncompromised while mir
3. Analyze room-specific drug usage trends to identify areas for improvement in resource allocation, such as focusing on reducing non-generic drug use in rooms with high outpatient (RAWAT JALAN) and UGD activity, thereby

04
Kesimpulan

Kesimpulan

- IBM Granite dapat digunakan untuk mengklasifikasikan tren penggunaan obat, baik berdasarkan jenis perawatan maupun periode waktu.
- Model ini mampu membuat ringkasan dari data, sehingga memudahkan dalam memahami pola yang terjadi.
- IBM Granite juga bisa memberikan rekomendasi umum terkait perubahan tren yang ditemukan.
- Hasil menunjukkan Granite cukup efektif sebagai pendukung analisis data ketika digunakan bersama tools Python seperti pandas dan matplotlib.

Terima Kasih